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AGRICULTURAL JOURNAL

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REPORT OF THE GENETICIST FOR THE YEAR 1933-34.

By

A. E. S. McINTOSH, B.Sc., Ph.D.

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SECTION I.

SUGAR CANE.

A INTRODUCTION.

(A) SUGAR CANE BREEDING.

The work of the Cane Breeding Station continues to expand in the efforts to satisfy the various seedling requirements of the sugar cane areas in the British West Indies. These requirements have been detailed in a series of reports by the writer on his visits to Trinidad, St. Kitts, Antigua, St. Lucia, and, more recently, Jamaica.* Briefly it may be stated that these requirements for all areas concerned fall under three general categories:—

(1) Areas which resemble the higher and lower rainfall districts of Barbados.

(2) Areas which on account of differences in soil or for some other factor (other than those outlined in (3)) do not approximate to conditions in Barbados.

(3) Areas which on account of some major disease (e.g. mosaic disease in Jamaica) or pest (e.g. frog-hopper in Trinidad) and apart from any consideration of soil or climatic environment involve distinct breeding problems.

The scheme of breeding seedlings for areas under the first category has altered only in extent and not in kind from that previously employed in the work of producing commercial seedlings for Barbados. The pen-ultimate selections of seedlings for Barbados in this category are being and will continue to be despatched by way of the Plant Quarantine Station in Trinidad to the Islands possessing suitable areas, where they will be recommended for immediate inclusion in variety trials.

The requirements noted under categories (2) and (3) have necessitated an expansion of the breeding work to include parents of a type or types considered suited, when crossed with noble varieties, to infuse into the seedlings of such crosses the characteristics necessary to their commercial success under (unfavourable) environments not met with in Barbados and at the same time to incur the minimum loss in such seedlings of those features of the noble cane which are of recognised commercial value under West Indies conditions.

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* (1) McIntosh, A. E. S. 1933. Report on the Sugar Cane Breeding Problems of Antigua, Trinidad and St. Kitts, B.W.I. Sugar Cane Breeding Station, Bull. No. 1.

(2) „ „ 1934. Report on the Sugar Cane Variety Problems in St. Lucia. Ibid Bull. No. 2.

(3) „ „ 1934. Report on a Visit to Jamaica. Ibid Bull. No. 3.

It is considered highly improbable that purely noble seedlings would satisfy all these requirements. At the same time they are essentially suited to the growing seasons in the West Indies, in which respect existing seedlings of other than noble parentage appear to be, to a large extent, unsuited. Many of the latter, however, possess characteristics which when allied with noble seedlings may prove successful in environments where present varieties prove uneconomical.

Accordingly, such considerations have necessitated arrangements for nobilising wild canes to such an extent that the resulting seedlings may possess that blend of the characters of both which will make them commercially successful in those areas. The following wild canes will be used—*Saccharum spontaneum* (three forms from India and first nobilised Java glagah-Kassoer), *Saccharum barberi* (Chunnee, Hemja, Hathooni), *Saccharum sinense* (two forms of Uba).

For evident reasons, such seedlings will only be grown for the first or, at most, the second season in Barbados. They will then be despatched, after quarantine, to their approximate areas where they will be submitted to preliminary small scale tests, and the survivors from the latter to a series of increasingly large trials and selections.

It is hoped to effect close co-operation between the stations and the personnel in each Island responsible for such tests. The information received from such tests will prove of value in guiding future breeding work.

(B) SUGAR CANE—SPECIAL INVESTIGATIONS.

These may be conveniently considered under two categories, i.e. (1) investigations concerning growth, development and ripening in the sugar cane and (2), gumming disease studies.

In the investigations under both categories, the varietal aspect is stressed.

The objects underlying the studies in the first category are to obtain fundamental information on the essential differences in growth and development between varieties, and to note in these respects the existence of any differential responses by varieties to altered environments. One aspect of these investigations has already been considered in a publication by the writer.* It is expected that the results of these studies will have application in the selection of parents for breeding, and in the allocation of seedlings to the British West Indies areas.

The objects of the gumming disease studies are, to obtain further information on the reaction of varieties to gumming disease, to evolve a method for the ready detection of the degree of varietal resistances to the disease, and to note the degrees of resistance inherited by populations of seedlings from a wide range of crosses.

All these special investigations are being carried on from year to year and will be reported in detail from time to time in separate publications. An outline report on the progress of each is given for the season under review in the Agricultural Journal, Volume 3, No. 2, pages 34—37 inclusive.

* McIntosh A. E. S. 1934. Sugar Cane Growth Measurements in Barbados. Dept. Sci. & Agric. Barbados. Agric. Journal Vol. 3 No. 1, pp. 1—29.

B. SUGAR CANE BREEDING, SEEDLING SELECTION AND TRIALS.

(i) SUGAR CANE BREEDING—B. 35′ SERIES.

Sugar cane breeding was carried out at Lion Castle estate during October, November and December, 1933.

All seedlings subsequently planted out were derived from crossing. The safety of the crosses was assured by enclosing the arrows of the female parents in arrow lanterns. Eighty of these lanterns were employed.

The crosses made are presented below:—

A. Crosses between noble varieties (Saccharum officinarum).

These are sub-divided into:—

(i) Proven Crosses (i.e., those of which seedling populations have already been tested and are of sufficient value to warrant further plantings). These are crosses between Barbados varieties of different lines in descent; thus, Ba.11569 crossed with each of the following, S.C.12/4, B.417, Ba.8069, B.H.10(12), Ba.6032, B.606, B.603.

(ii) Experimental Crosses, (i.e., those derived from crossing Barbados varieties for the first time (trial marriages) or crossing Barbados varieties with imported noble varieties):—

(a) Barbados Crosses:—

Ba.11569	x	W. Trans.
„	x	B.376.
„	x	Burke
„	x	B.694
B.376	x	S.C.12/4
*Rock Hall	x	B.H.10(12)
*Red Unknown	x	„

(b) Barbados varieties crossed with imported noble varieties:—

Ba.11569	x	D.1135
„	x	Q.813
„	x	H.Q.409.

B. Nobilisations of Saccharum spontaneum.

These were:—

(1) further nobilisations with Barbados varieties of the P.O.J. varieties 2364, 2725, 2878, which themselves represent second and third nobilisations of Java glagah (*S. spontaneum*).

* These are old Barbados varieties which have not been identified.

(2) back crosses of previously acquired seedlings of such crosses to Barbados varieties; and

(3) crosses between such seedlings and P.O.J.2878.

In all forty-four crosses were carried out under this head.

C. Nobilisations of Saccharum barberi.

Under this head the following crosses were made:—

Ba.11569	x	P.O.J.234.
P.O.J.213	x	B.H.10(12).
Co.213	x	B.H.10(12).
Co.213	x	B.391.

D. Crosses involving the Production of Seedlings with Blood of all Three Species.

Ba.11569	x	Co.281
B.3215	x	Co.281
Ba.11569	x	Co.290
Co.290	x	B.H.10(12).

Considerable time was devoted, during the arrowing period, to determining the sex of those varieties being used as parents for the first time. The object of this was to ensure that by the use of male sterile varieties only as female parents, any seedlings resulting from the arrows should be crosses with the selected male parent and not selfings.

The following features indicated male sterility:—

(1) the production of shrivelled or plump but non-dehiscing anthers;

(2) the production of anthers which dehisced but shed little pollen, comprised chiefly of distorted or empty pollen grains.

In the majority of cases male sterility was marked, and varieties with this feature were used as female parents.

In a few cases, e.g. Co.290 and B.376, there were indications of a weak male fertility. Arrows of such varieties were selfed, and, at the same time, in breeding, they were used both as male and female parents.

Throughout the breeding work the lantern was treated as the unit, and records made for each as to the actual cross, the number of arrows (usually four), and, for each arrow, its first and last dates of flowering and dates of harvesting and sowing.

In each lantern, dusting (pollination) was carried out with arrows of the selected male parent at some time between the hours of 7.30 a.m. and 8.30 a.m.

daily, from the date of first flowering of the earliest arrow till the date of last flowering of the latest arrow.

All male arrows, or flowering portions of male arrows, required for each morning during the breeding were collected from 5.00 a.m. to 7.00 a.m. Arrows of varieties were kept distinct in paper covers and laid in the breeding hut where the anthers dehisce slowly, but do not shed until taken out and shaken sharply over the female arrows in the lanterns. These times are decided on from sugar cane flowering periodicity studies already made.

(ii) SEEDLING RAISING AND PLANTING OUT—B.35′ SERIES.

Each arrow was allowed to ripen fully in the shelter of its lantern. When ripe, the arrows were cut, each placed in a bag and hung in a shed for three days. The fuzz was then stripped and sown in boxes. The sowings from each arrow retained their identity throughout. Germination counts were then made for the fuzz from each arrow. In this way the history of each arrow is determined in respect to its date of first flowering, duration of flowering and pollination, duration of the ripening period, and extent of seedling production. The effects of the actual cross, the individual arrow and lantern on fertilities are finally established. These figures are used as guides in future breeding work.

All crosses between noble varieties proved highly fertile with the exception of the cross Ba.11569 x White Transparent (Light Preanger). The male parent, in this case, when selfed did not give any seedlings. Determinations on its sex had shown it to give a feeble pollen shed, the pollen grains for the most part being misshapen and empty. In future this variety will be used as a female parent.

P.O.J.'s 2364 and 2725 showed high fertilities when crossed with noble varieties.

The majority of the 4th and 5th glagah nobilisations (i.e. the back crosses to Barbados varieties) were highly fertile.

The Chunnee nobilisations were not so fertile as the glagah nobilisations. The following crosses gave poor germinations:—P.O.J. 213 x B.H.10(12), Co.213 x B.391 and Co.213 x B.H. 10(12).

In regard to the selfing work, Co.290 showed considerable self-fertility. In future it will be used as a male parent only.

The seedlings were potted in six-inch pots during January and February, 1934. In all, 20,000 were potted. This included 12,000 seedlings of the proven crosses:—Ba.11569 crossed with S.C.12/4, B.417, Ba.8069, B.H.10(12), Ba.6032, B.606, two proven back-crosses, B.(30)L6 x B.H.10(12) and B.(30)L6 x S.C.12/4. (B.30)L6 is a seedling of P.O.J.2364 x B.391.).

The remaining eight thousand seedlings consisted of seedling populations derived from fifty-two trial marriages.

The populations of all crosses were kept distinct in the cisterns.

The seedlings were planted out into the field at the end of April and beginning of May. The lay-out employed was, in essentials, similar to that of last year.

The numbers and allocations were as follows:—

A. *Proven Cases.*

(a) For early reaping during crop—five crosses	..	3,224
(b) For late reaping during crop—four crosses	..	3,415

B. *Trial Marriages.*

Forty-six crosses, plus one standard proven cross (i.e., Ba.11569 x B.H.10(12))	..	3,424
Grand Total	..	10,063

These seedlings will be reaped in 1935 and selections for further trial and for use as parents will comprise the B.35′ series of seedlings.

Note:—The first year seedlings were planted out in April and cut during the crop of the succeeding year. They thus have a growing period in the field of approximately 10—12 months. The average length of growing season in the West Indies is 15—18 months for plant canes. It has been shown definitely that populations of seedlings which are derived from short season varieties, e.g., P.O.J.'s 2364 and 2725, perform extremely well as first year seedlings (i.e. when grown for 10—12 months) when compared with seedlings from the best Barbados crosses. In the second season of test (i.e. in a growing season of 15—18 months), however, it has also been proved that selections of seedlings from the Barbados crosses are definitely superior to selections of seedlings bred from short season varieties, although the latter selections were definitely better in the first year. The second season of tests lasts for the normal duration of the West Indian growing season.

These results are explained thus. In the 10—12 months of the first year seedling test, short season seedlings grow quickly and for no longer than the duration of the test. The shortness of the growing season, prior to arrowing, suppresses the latter. Seedlings with a comparatively long growing season (e.g., seedlings derived from Barbados crosses) have not the necessary time in the first year to carry out their growth to the full.

The trial marriage plantings consist of a range of crosses where long and short season varieties are employed as parents. It is evident that misleading results for West Indies conditions may be obtained if comparisons of seedling populations are made on a first year's test of a 10—12 months' duration. While it is known that many of the imported short season P.O.J. and Co. (Coimbatore) varieties endow good characteristics to seedlings, e.g., disease resistance and growth vigour, it is not desirable to acquire, in their selected seedlings, the short season feature. For reasons stated above, seedlings possessing this feature perform comparatively well in the first year and it is almost impossible to avoid selecting them.

With a view to improving the value of the trial marriages, and selections from them, it is the intention to grow their seedling populations in the first year over a 15—18 months' season, i.e. from November of any year to approximately March of the next year but one. It is hoped to effect this by storing the fuzz of any one breeding season and sowing it in time to give seedlings ready for planting in November, or by planting at the normal time in April and replanting from cuttings in November. These methods will be tried at first on a small experimental scale.

(III) RESULTS OF REAPING FIRST YEAR SEEDLINGS—B.34′ SERIES.

These seedlings were bred in 1932, planted out in April 1933, and reaped during the crop in 1934. Their parentages and time of planting them in the field, with the lay-out employed, are given in the Report of the Geneticist for the Year 1932–33, pages 1—3 inclusive.

During the 1934 crop, three lots of these seedlings were reaped at separate times. These lots were:—

(a) proven crosses—early group,
(b) proven crosses—late group,
(c) trial marriages.

The Proven Crosses. The early group was reaped in January and the late group at the end of April.

The same procedure was adopted for making selections at both reapings. The seedlings were cut, the canes of each gathered into a bundle, and the bundles laid alongside one another. These bundles were periodically inspected close behind the cutters. Bundles possessing canes of good appearance were selected, the sound and rotten canes in each numbered, and the bundle weighed. Canes were cut to note the presence or absence of hollowness or pithiness. Final field selections were then made. The advantage of periodic inspection close behind the cutters lies in the observer being able to note fluctuations in the yielding capacities of small soil areas and thus adjust the selection weight for each. The bundles of field selected seedlings are divided into two, the one possessing the same number of canes of approximately similar ages as the other. Sucrose per cent. in juice determinations are made for the canes in one division, and the canes of the other are sent to the Experiment Station.

With field and laboratory data available for each field selection, a final selection is made at the Experiment Station.

These final selections are given permanent "B" (Barbados) symbols in which the first two figures represent the year of selection and the last two the actual number of the seedling at selection. These selections enter into the routine scheme of trials in Barbados as competitors of the existing standard commercial varieties.

The selections are given below:—

TABLE I.

FIRST YEAR SEEDLINGS—B.34′ SERIES.

LIST OF FIELD AND FINAL SELECTIONS.

(1) Early Group.

Cross.	No. Reaped.	No. Selected in Field	No. Final Selections.	Permanent Numbers.
Ba.11569 x S.C.12/4 ..	783	66	15	B.3401—05, 07—16
„ x B.417 ..	431	39	11	B.3417—23, 26—29
„ x Ba.8069 ..	463	32	3	B.3430—32
„ x B.702 ..	207	10	1	B.3424.
Totals	1,884	147	30	

(2) Late Group.

Cross.	No. Reaped.	No. Selected in Field	No. Final Selections.	Permanent Numbers
Ba.11569 x B.H.10(12) ..	830	75	24	B.3440—63
„ x B.606 ..	796	72	9	B.3464—72
„ x B.603 ..	254	27	11	B.3473—83
„ x Ba.6032 ..	481	57	12	B.3484—95
Totals	2,361	231	56	

In the early group two were discarded, i.e. B.3406 and B.3425, after cutting plants, on account of hollow and dry centres.

In future the proven crosses, Ba.11569 x B.702 and Ba.11569 x B.606 will be discarded on account of their comparatively low percentage final selections. The cross Ba.11569 x Ba.8069 will be transferred to the late group, while the number of seedlings planted of the cross Ba.11569 x B.603 will be considerably increased on account of the very good performance of its seedlings.

A high number of final selections—56—was made in the late group. This was on account of the general high standard of seedlings obtained from crosses in this group.

The Trial Marriages. The objects of testing the crosses in this group of seedlings are threefold:—

(1) to test, by means of an adequate population of each, the value of the crosses as seedling producers, with a view to promoting the best to the proven cross group and eliminating others from further breeding,

(2) to obtain selections from those crosses whose seedlings may serve for unfavourable soil and other conditions in the British West Indies, and

(3) to select seedlings for use as parent plants in further nobilisations in breeding.

The trial marriage block consisted of populations of seedlings from thirty-two crosses and four selfings. A population of the proven cross—Ba.11569 x B.H.10(12)—was included to serve as a standard of the proven crosses, and thus make possible the selection of crosses for promotion to the proven cross group.

At reaping during March the usual field data was obtained for every seedling and sucrose per cent. in juice determinations from an adequate sample of seedlings from each population. From this data the usual sets of tables—as exampled in previous reports—were made.

Fifty-nine seedlings were selected. These were divided into three lots, i.e.:—

(1) seven seedlings, of noble variety parentage, numbered B.3433—B.3439,

(2) thirty-eight seedlings derived from a wide range of parental types and numbered B.34100—B.34138, and

(3) fourteen seedlings derived from P.O.J.'s 2364, 2725, 2878, and Co.281 crossed with several Barbados male parents.

Seedlings in the first lot will be included with the selections from the proven crosses already noted. Those in the second lot are to be tested in a second year trial during the season 1934—36; this, in order to determine their possible commercial value in Barbados and other British West Indian Islands. The seedlings in the third lot are retained essentially for breeding purposes.

(IV) NOTES ON MINOR SELECTION PLOTS—B.33′ SERIES.

These were selected in their first year seedling stage during the crop of 1933 for further trial in Barbados.

According to the recently altered scheme, such first year seedling selections are not planted in the second year trials until the November of the following year, (previously they were planted in the second year trials in the November following their selection). The objects of delaying the planting of these selections in second year trials are:—

(1) to give sufficient time to provide *adequate* planting and supplying material for this trial, and

(2) to effect, if possible, a minor selection in the plots which serve for multiplication.

The first set of these plots is at Codrington. These are grown from the time of the selection in the first year till the next crop when they are reaped and weighed and two sucrose per cent. juice analyses made for each seedling. The second set of plots is planted at Dodds plantation in November of the first year, from planting material derived from the plots at Codrington. Two features are noted at Dodds for each seedling, i.e.

(1) the presence or absence of arrowing, and, if present, the extent, and

(2) the degree of resistance to gumming disease, as determined by the extent of development of leaf symptoms of the disease.

With the data available for each seedling from the plots at each station, those seedlings which possess any of the following features are eliminated from further trial:—

(1) heavy arrowing.
(2) poor appearance of individual canes and poor average stool weights,
(3) low sucrose percentage in juice, and
(4) ready susceptibility to gumming disease.

The B.33′ series of seedlings consists of an early and late group. Both were planted in plots of ten cane holes each at Codrington Experiment Station after their selections from early and late reapings respectively of first year seedlings.

During November one stool was used in each seedling plot to provide cuttings to plant a twenty-four hole plot at Dodds plantation.

During crop, the seedlings of the early group at Codrington were reaped and the features (1) appearance of canes, (2) weight of canes, and (3) per cent. sucrose in juice were ascertained. Seventeen seedlings were eliminated on these bases. This leaves a total of twenty seedlings in this group which have yet to survive the arrowing and gumming disease resistance tests at Dodds prior to being planted in second year trials in 1934.

The late group seedlings had not sufficient time to make adequate growth to carry out such a test at Codrington Experiment Station. Consequently, minor selections on these are delayed and will be made in their plots at Dodds, when the features, arrowing, appearance of canes and gumming disease resistance will be the criteria for elimination.

(v) SECOND YEAR SEEDLING TRIALS—B. 32′ SERIES.

These were selected as first year seedlings in 1932. They were divided into an early and late group according respectively as selections were made from early or late reaped first year seedlings. Both groups of seedlings under the old scheme would have been planted in second year trials in November, 1932. About this

time it was decided to alter the scheme in the manner indicated above for the B.33′ series of seedlings. For the B.32′ series it was decided to plant the early group in second year trials in 1932 (the old scheme), and retain the late group for planting in 1933 (the new scheme).

At Codrington, during the crop of 1933, and at Dodds during the season 1932—33, minor selections were made in the *late* group. Of the thirty-one seedlings of this group selected as first year seedlings in 1932, and as a result of these minor selections, ten were eliminated, eight retained for breeding purposes only, while thirteen were selected and planted in second year trials at Dodds and Lemon Arbor for the season 1933—35.

The *early* group was tested against standard commercial varieties in second year trials at Dodds and Lemon Arbor during the season 1932—34.

The lay-out, the methods of reaping, selecting, and statistically analysing the results were essentially similar as in previous years' second year trials.

Of the twenty-seven seedlings tested, three were selected for further trials.

One of these selections, B.3234, yielded so well at Lemon Arbour (the high rainfall station) and possessed such a good appearance as to justify its direct promotion to variety trials chiefly as a competitor of B.H.10(12) for the later reaping in crop in the intermediate and higher rainfall districts.

The remaining two selections—B.3216 and B.3239—were chosen for further trial in select seedling trials and maturity experiments. As is usual for seedlings promoted to select seedling trial stage, the growth of their aboveground parts will be measured in the maturity experiments. The advantage of these measurements has been noted in a separate publication to which reference has already been made.

Both those seedlings will be tested against the commercial varieties in the intermediate and higher rainfall districts.

The value of testing any series of second year seedlings under two rainfall environments in Barbados has been demonstrated conclusively within the last four years of these trials (i.e. since their inception). It can be stated that the now commercial variety, B.2935, would have been eliminated in its second year trial on its performance at the higher rainfall Station—Lemon Arbor—while the promising seedlings B.3013 and B.3234 would have been eliminated if they had been tested at Dodds (the lower rainfall station) only.

These results appear to emphasize the necessity of testing any series of seedlings under different environments at as early a stage as practicable in any series of trials.

A possible explanation for these differential responses by seedlings to different rainfall environments in Barbados has been described in the publication already referred to.

(vi). *Notes on Seedlings—B.31′ Series.*

These seedlings were selected as first year seedlings in 1931, as second year seedlings in 1933, and planted in select seedling trials and maturity experiments in 1933 for test during the crop 1933-35.

Growth measurements of the above-ground parts of each are being carried out in the maturity experiments. These measurements, while giving fundamental information on the growth type of each, also serve to keep each under fortnightly observations throughout the year. These observations assist in determining their probable future use.

(vii). *Select Seedling Trials—B.30′ Series.*

These trials were designed to test second year selections of the B.30′ series of seedlings—B.3011, B.3013, B.3038, B.3063, B.3078—against the existing standard varieties—B.H.10(12), B.726, B.891, Ba.11569, B.2935. The Java variety, P.O.J. 2878, as being the best of the imported Java varieties, was included in these trials for a second time.

Six stations were selected to give a range in soil and climatic conditions. These were:—

(1) Six Men's—Sandy coral limestone soil, low rainfall area.

(2) Mangrove—Shallow black limestone soil, low rainfall area.

(3) Small Ridge—Shallow black limestone soil, low to intermediate rainfall area.

(4) Buttals—Valley deep black coral limestone soil, low to intermediate rainfall area.

(5) Bowmanston—Shallow red coral limestone soil, intermediate to high rainfall area.

(6) Canefield—Shallow red coral limestone soil, high rainfall area.

Unfortunately, the important trial at Mangrove was destroyed by fire in December, 1933, and could not be reaped as a trial.

At each station two contiguous trials were planted—one for early and the other for late reaping. The soil at Six Men's lost moisture so rapidly that both trials had to be reaped early. The figures given for the varieties at this station are the averages of the two reapings.

The rainfall during the season was exceptionally high. This promoted higher yields than is usual at Six Men's and Small Ridge, and, coupled with the low rainfall crop period, was responsible for loss of tonnage through rotting and drying out of cane. This was especially marked at the valley deep black

coral limestone station—Buttals—where considerable waterlogging took place during the growing season.

On reaping at Canefield the plots revealed high irregularities in their yields which must have been due to soil irregularities which were not apparent when selecting the site. The variation within the blocks was greater than that between blocks. Consequently the results from this trial are considered to have a very limited value.

The trials at Small Ridge, Bowmanston and Six Men's were highly satisfactory.

The lay-out employed at each station was essentially that used in previous years.

A summary of the variety yields at each station of the important feature—sugar in pounds per acre—is given on Figs. 1 and II.

The results are considered here. The standard varieties B.H.10(12), B.726, B.891, Ba.11569 and the new commercial variety, B.2935, are considered in section (ix) on Variety Trails and will be regarded here for purposes of comparison only.

Of the B.30′ series of seedlings, B.3038, B.3063 and B.3078 are decidedly inferior to the standards and have been eliminated.

On account of the destruction of the Mangrove Trial B.3011 was reaped at Six Men's only. Here it equalled the standards Ba.11569, B.726 and B.891. This seedling has been re-included in the 1933-35 select seedling trials.

B.3013 was reaped in early trials at Canefield and Bowmanston and in late reapings at Canefield, Small Ridge, Buttals, Bowmanston. At the late reaping at Canefield it performed poorly, but the unreliability of this trial has already been indicated. At the other five reapings it has performed sufficiently well to warrant its inclusion in variety trials for season 1934—36. Its chief attributes are an exceedingly high juice quality, a long vegetative growth period in its canes with very little rot or drying out in the latter, ease of reaping and marked resistance to gumming disease. Indications are that this seedling may be well suited to good cane growing lands in other British West Indian Islands where the growing season is long. It will be distributed for trial in such places. In Barbados it appears to be essentially a competitor of B.H.10(12) and B.726 (more particularly the latter) and it will be allocated accordingly in the variety trials.

P.O.J. 2878. In the report for 1932-33 on page 11 are given notes on this variety. These notes were derived from growth measurements, maturity experiments and select seedling trials during season 1931-33. The conclusions there were that this variety could not be said to offer promise as a commercial variety

in Barbados, but that it would be reaped again in select seedling trials in 1934 when its value in Barbados could be more fully demonstrated.

The season 1932-34 differed from that of 1931-33 in that the rains were earlier and stool formation earlier. In P.O.J. 2878 this has the effect of suppressing late cane formation. This in turn promoted high juice qualities early in this variety. It is seen from the figures, however, that P.O.J. 2878 is not on the average so good as the standard varieties and cannot as a result be recommended for commercial planting.

It is retained at the Cane Breeding Station for use as a male parent in breeding

(viii) *Select Seedling Trials—First Ratoons.*

Three of the plant cane select seedling trials of 1931-33 were ratooned during season 1933-34, i.e. Buttals, Blackmans and Clifton Hall. Standard varieties, promising select seedlings and the Java variety P.O.J. 2878 were reaped. For each plot the yield of cane and the number of dead canes were ascertained.

The exceedingly high rains caused appreciable rot of cane. This was especially marked at Buttals and Clifton Hall. The number of dead canes in B.2935 at the higher yielding station, Clifton Hall, was especially marked.

The yields are summarised in Table II below.

TABLE II.

Station	Variety and Yield in Tons per Acre					Significant Difference between Mean Tonnages of Varieties
	B.726	B.H.10.(12).	B.2935	B.2931	P.O.J.2878	
Buttals	23.20	——	20.26	18.77	22.63	± 4.64
Blackmans	27.53	29.66	30.85	19.22	32.10	± 2.79
Clifton Hall	31.04	35.59	23.67		41.61	± 5.36

B.2931 gave some promise as a plant cane variety in the 1931-33 select seedling trials. It performed poorly as a ratooner and will be discarded.

B.2935 ratooned comparatively well at Blackmans and Buttals, but was very poor at Clifton Hall. At the last mentioned station an exceedingly high number of its canes were dead. It is considered highly improbable that B.2935 will ever be recommended for such good conditions as were exampled at Clifton Hall in this series of ratoon trials, being, as will be shown in section (ix) a variety for the lower rainfall district. Special provisions have been made to ratoon B.2935 in large scale trials in the lower and lower to intermediate rainfall areas (q.v. section (ix)).

FIG I.

SELECT SEEDLING TRIALS. EARLY REAPING.

PLANT CANES.

SACCHAROSE IN THOUSANDS OF POUNDS PER ACRE.

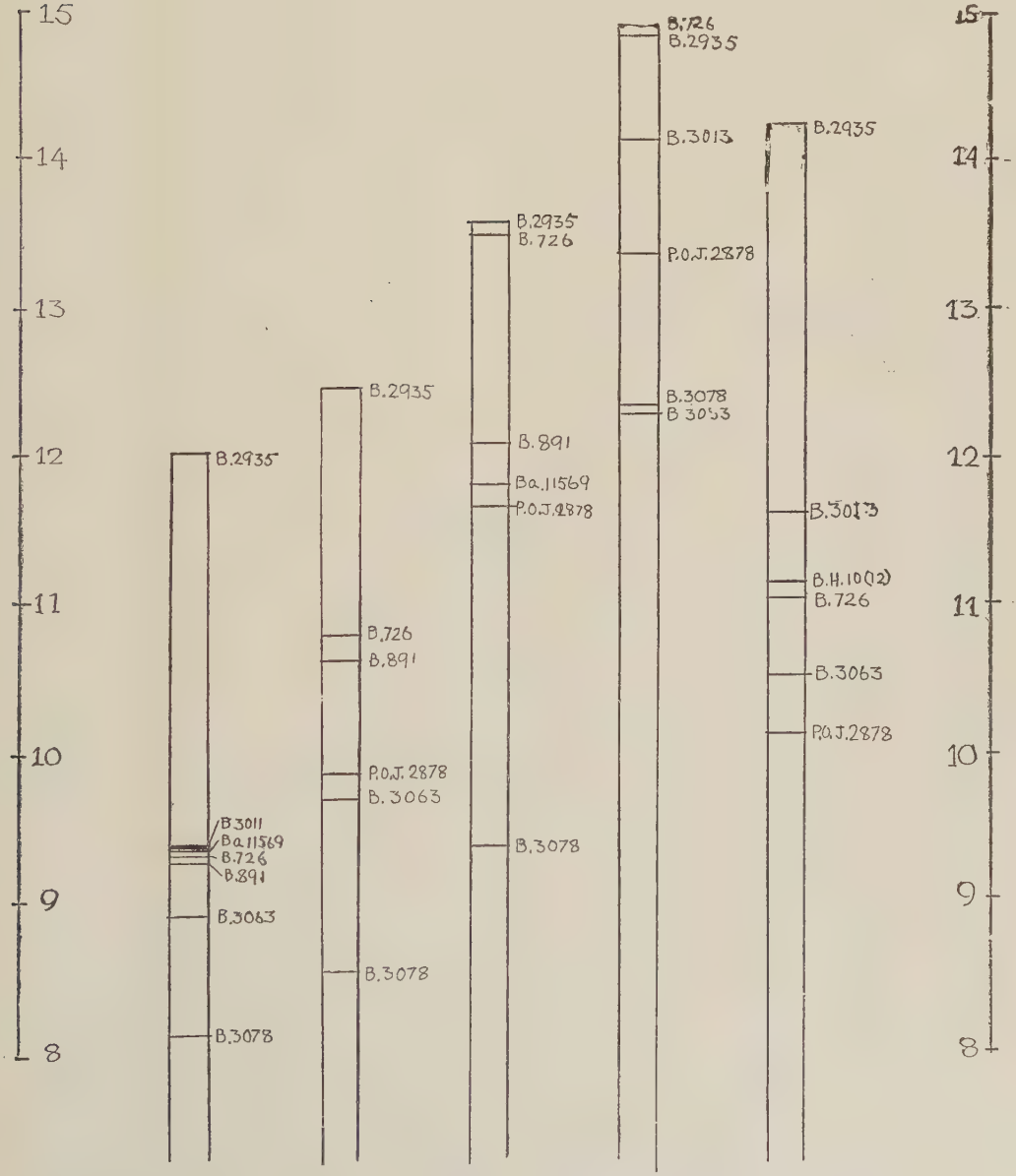
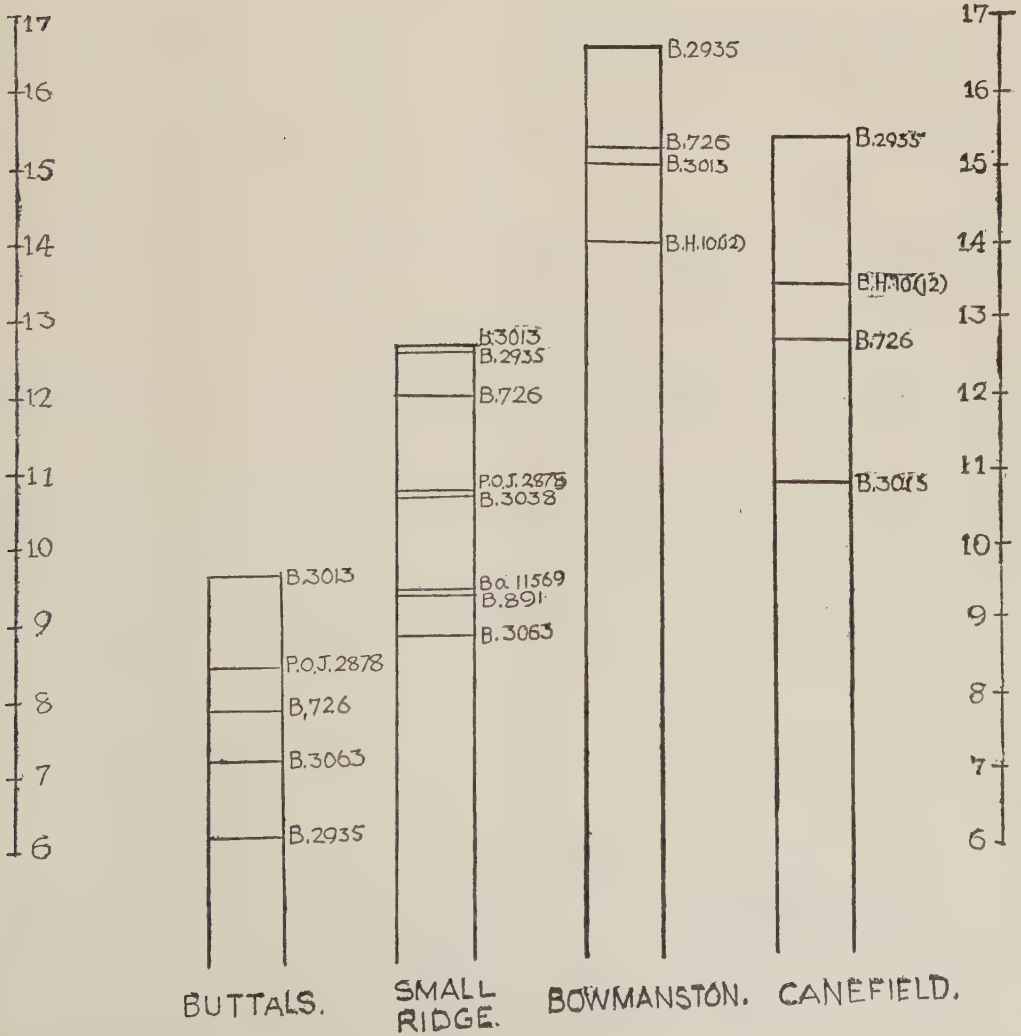


FIG II

SELECT SEEDLING TRIALS LATE REAPING.

PLANT CANES

SACCHAROSE IN THOUSANDS OF POUNDS PER ACRE.



P.O.J. 2878 yielded well in the ratoon trials, but, owing to its comparatively poor performance as a plant cane variety (q.v. section (vii)), and its fluctuating juice qualities, it cannot be recommended for commercial planting in any part of the Island.

(ix) *Variety Trials—B.29' Series.*

The routine scheme of testing and selecting seedlings from their first year trial stage until the select seedling trial stage has been shown by the previous sections in this report. It was also stated that seedlings surviving to the select seedling trial stage are tested during the same season as the latter in maturity and growth measurement experiments.

Thus, at the conclusion of these trials and experiments, it is fairly well known, for each seedling, not only if it gives promise to become a commercial variety, but also to which ecological areas and to which time of reaping it is best suited.

It is considered necessary, before recommending any seedling for large-scale plantings, for it to be tested on a minor plantation scale against the existing commercial variety or varieties growing in the environments for which it is proposed.

With this end in view a new type of trial—called a *variety trial*—was started during the season 1932—34.

Previous trials and growth measurements had indicated that the seedling B.2935 showed decided promise as a commercial variety for the lower rainfall districts in Barbados and preferably for later reaping during crop.

In order to test those indications, variety trials were laid down at twelve plantations in the lower rainfall district. These plantations were chosen to represent a sandy coral limestone and black coral limestone soils of varying depths in low and low to intermediate rainfall districts.

Officers from the Department of Agriculture selected trial sites of apparent uniform soil conditions on each of twelve plantations. In view of the considerable size and number of those trials, it was considered necessary that the plantations should assist by providing labour to plant and reap them and by having the canes weighed at nearby factory scale beams. To ensure accuracy, the planting and reaping were supervised by a field officer of the Department of Agriculture, and weighings were done by cane weighers at each factory.

The fact that plantation labour was employed in these trials necessitated the use of a comparatively simple lay out. Thus, three varieties were tested in each trial (i.e. B.2935 and two of the three standards Ba.11569, B.726, B.891.), four randomised blocks were used, and the plots were strips of 4 x 40 or 6 x 30 cane holes. The widths of the plots i.e. four and six cane holes, were used according respectively as cane cutters on the plantations concerned cut in lines of two or three rows. As far as was convenient the plots were laid down with their narrow ends at right angles to the prevailing wind to enable the cutters to cut in the breeze—an important consideration.

At crop, two cutters reaped any one plot and threw the canes into one row between them. This avoided mixing the canes of adjoining plots and facilitated their loading into carts. The carter was given a printed ticket on which the supervising field officer had noted the plantation, date, variety, plot and number of load. This ticket was carried by the carter to the scale beam where the cane weigher inserted the weight of the load.

The canes in these trials were not chemically analysed; this being done for the varieties concerned in the smaller select seedling trials and maturity experiments.

On Table III the plantations are noted by numbers and their situations, soil types and rainfalls for the growing season are given.

The trial areas were cultivated and manured according to the usual practice of each plantation.

On one plantation the canes in the trial were reaped before the appointed date, and yield figures were not obtained. This reduced the number of trials reaped under supervision to eleven.

TABLE III.

Plantation No.	Parish.	Soil Type.	Rainfall in Inches.													
			1932.		1933.											
			Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1	St. Peter	Sandy Coral Limestone.	10·06	6·65	3·31	2·33	1·34	1·86	1·52	5·44	12·06	9·23	9·91	14·61	12·01	5·77	96·10
2	St. George	Deep Black Coral Limestone.	9·25	7·16	6·14	2·44	1·20	2·77	2·78	3·57	8·63	8·60	11·41	13·90	10·91	5·52	94·28
3	St. Lucy	Shallow Black Coral Limestone.	5·66	5·79	3·27	2·09	0·73	1·95	0·65	4·30	8·35	14·05	9·60	11·75	11·25	4·30	83·74
4	St. Lucy	„	9·85	4·83	3·56	1·85	0·83	1·97	1·16	5·04	8·36	12·25	9·40	11·12	10·99	3·86	85·07
5	Christ Church	„	13·30	7·07	4·74	1·67	1·03	2·16	0·95	5·05	8·16	9·63	9·01	8·10	10·67	5·78	87·32
6	„	„	11·56	8·40	4·60	2·07	0·92	2·53	3·31	4·66	8·65	10·52	11·29	11·21	9·93	5·62	95·27
7	„	„	6·22	4·30	2·89	1·41	0·48	1·90	0·91	3·50	7·06	6·54	7·76	6·57	11·25	4·20	64·99
8	St. Philip	„	8·35	5·59	3·34	1·77	0·89	2·24	2·74	4·65	7·70	8·69	11·90	7·85	9·19	5·93	80·83
9	„	„	6·99	6·87	4·67	1·66	1·29	2·11	1·93	3·54	6·86	10·11	12·37	6·74	9·36	5·50	79·20
10	„	„	7·14	6·19	5·44	1·31	1·56	1·54	2·05	4·08	7·50	8·95	12·18	9·13	11·18	4·51	82·76
11	„	„	10·16	7·36	5·16	1·79	1·05	2·63	1·73	2·92	7·27	7·34	13·36	8·18	12·13	5·07	86·15

A summary of the yields is given in Table IV.

TABLE IV.

Plantation Number.	Variety and Yield in Tons per Acre.				Mean Yield of all Varieties.
	B. 2935.	Ba. 11569	B. 891.	B. 726.	
6	51.17	..	36.72	40.73	42.87
8	48.34	36.85	38.44	..	41.21
10	45.84	37.28	36.00	..	39.71
2	41.02	..	35.20	39.80	38.67
7	42.46	33.02	38.84	..	38.11
4	40.21	34.42	..	32.73	35.79
3	39.83	32.37	31.21	..	34.47
5	37.42	29.19	29.09	..	31.90
11	35.56	26.82	..	28.33	30.24
1	33.39	30.52	25.80	..	29.90
9	32.75	27.24	23.61	..	27.87
Mean Yield of Individual Varieties.	40.73	31.97	32.77	35.40	35.52

There is no positive correlation between the yields and the total rainfall of individual plantations.

In regard to rainfall distribution, it can be seen that rains were uniformly high, and soil moisture could not have been a limiting factor to effective growth from July to December. The rainfall from January to April was comparatively uniform over all the plantations. The early rainy season months, i.e., May and June which have been shown previously to be critical ones in affecting the subsequent yields, show considerable variation. This is especially so in May, and it is interesting to note a suggestive relationship between the May rainfall and the yields, in that those plantations with higher rainfall in May gave a higher average yield.

Apart from the effect of rainfall distribution there can be no doubt that the yields were influenced greatly by individual estate field treatments both prior to and during the trial season.

With regard to the yields of the varieties tested, it is interesting to note examples of differential responses by varieties in yield under the different conditions existing on the plantations concerned. In this respect it is seen that, as conditions improve to give higher average yields, the variety B.891 improves in yield to a greater extent than Ba.11569, such that under conditions promoting lower yields Ba.11569 is definitely superior while under conditions favouring higher yields B.891 at least equals and is also better than Ba.11569. The other

example of differential response in yield is seen in comparing the yields of B.2935 and B.726. Whereas, at three stations the former outyielded the latter by 7—10 tons per acre, at one station the excess was little more than one ton per acre. This is very probably a soil effect. The trial at the latter station was situated in a field characteristic of the very deep black coral limestone soil. Such a soil type appears to favour particularly the growth of B.726.

With the two exceptions noted above the differences between the varieties at the eleven plantations are remarkably constant. These features prompt the following comparisons of variety yields:—

(1) B.2935 v Ba.11569—9 trials.
(2) B.2935 v B.891—9 trials.
(3) B.2935 v B.726—shallow black coral limestone soils—3 trials.
(4) B.2935 v B.726—deep black coral limestone valley soils—1 trial.
(5) Ba.11569 v. B.891—higher yielding trials—5 trials.
(6) Ba.11569 v B.891—lower yielding trials—2 trials.
(7) Ba.11569 v 726—2 trials.
(8) B.891 v B.726—2 trials.

The results are presented below:—

(1) B.2935 v Ba.11569—9 trials.

Mean Yields:—

B.2935 —39.53 tons per acre.

Ba.11569—31.97 „ „ „

Difference in favour B.2935=7.56 tons per acre.

Standard Error of Mean Difference ±0.531.

This difference is statistically highly significant.

(2) B.2935 v. B.891—9 trials.

Mean Yields:—

B.2935—41.36 tons per acre.

B. 891—32.77 „ „ „

Difference in favour B.2935=8.59 tons per acre.

Standard Error of Mean Difference ± 0.557

This difference is statistically highly significant.

(3) B.2935 v. B.726—3 trials (shallow black coral limestone soils).

Mean Yields:—

B.2935—42.31 tons per acre.
B. 726—33.93 „ „ „

Difference in favour B.2935=8.38 tons per acre.

Standard Error of Mean Difference ± 0.518.

This difference is statistically highly significant.

(4) B.2935 v B.726—1 trial (deep black coral limestone valley soil).

Mean Yields:—

B.2935—41.02 tons per acre.
B. 726—39.80 „ „ „

Difference in favour B.2935=1.22 tons per acre.

Standard Error of Mean Difference ± 1.428.

This difference is *not* statistically significant.

(5) Ba.11569 v B.891—higher yielding trials—5 trials.

Mean Yields:—

B. 891 — 34.72 tons per acre.
Ba.11569— 33.74 „ „ „

Difference in favour B.891 = 0.98.

Standard Error of Mean Difference ± 0.764.

This difference is *not* statistically significant.

(6) Ba.11569 v B.891—lower yielding trials—2 trials.

Mean Yields:—

Ba.11569—28.88 tons per acre.
B. 891 —24.70 „ „ „

Difference in favour Ba. 11569=4.18 tons per acre.

Standard Error of Mean Difference ± 0.452.

This difference is statistically highly significant.

(7) Ba.11569 v B.726—2 trials.

Mean Yields:—

Ba.11569—30.62 tons per acre.
B. 726 —30.53 „ „ „

Difference in favour Ba.11569=0.09 tons per acre.

Standard Error of Mean Difference ± 0.827.

This difference is *not* statistically significant.

(8) B.726 v B.891—2 trials.

Mean Yields:—

B.726—40.26 tons per acre.

B.891—35.96 „ „ „

Difference in favour B.726=4.30 tons per acre.

Standard Error of Mean Difference ± 0.572.

This difference is statistically highly significant.

Conclusions from the Variety Trials, 1932–34.

Qualitative analyses of canes of each of the varieties concerned have been made over a number of crops, from select seedling trials and maturity experiments. Moreover the yields of each have been obtained on a smaller scale in select seedling trials in previous crops, and the growth type of each is known from a series of growth measurements.

The following conclusions are made on the total experimental data available for each, and in respect of their value in the lower and lower to intermediate rainfall districts.

B.2935. This new variety has shown emphatic superiority as a plant cane over its essential competitor, Ba.11569.

In tonnage of cane it definitely out-yields the latter, its juice quality approximates to it, it is more resistant to gumming disease, and its canes do not rot so readily during crop. It also out-yields B.891 to such an extent as to more than compensate for a poorer juice quality than the latter, so that it excels it in yield of sugar per acre. In the majority of the black coral limestone soils it out-yields B.726 and gives a higher sugar yield per acre in spite of a juice quality inferior to the latter. In the deep black coral limestone valley soils it does not show any marked superiority over B.726. It appears that soil conditions here favour B.726, more particularly by encouraging a longer favourable growing season. When climatic conditions during the growing season are favourable, B.2935 loses weight during the subsequent crop to a greater extent than B.726. Under climatic conditions giving a shorter favourable growing season B.2935 out-yields B.726 appreicably in these valley soils (c.f select seedling trials 1931–33).

In summary, B.2935 is recommended as a plant cane variety in the majority of the lower and lower to intermediate rainfall areas. Further trials are necessary to determine how it compares with B.726 in the deep valley soils over a number of years, and, more especially, how it performs as a ratooning variety. In the latter respect, five of the variety trials are being ratooned for reaping in 1935.

Ba.11569. This variety at one time was the sheet anchor of a greater proportion of the lower and intermediate rainfall districts. Since 1930, B.726 has been planted on an increasing scale and has very largely eliminated Ba.11569 from the intermediate rainfall district, where the superiority of B.726 has been

definitely established. Under these circumstances Ba.11569 can only be considered as the predominant variety for the lower and lower to intermediate rainfall districts. In these areas B.2935 has now shown its decided superiority as a plant cane variety, and should be planted where plant canes only are being grown. Should ratooning trials show that B.2935 performs well, it is highly probable, and in view of the high susceptibility of Ba.11569 to infection by gumming disease, highly desirable, that the latter variety be eliminated entirely. In the meantime, and until information is obtained on the ratooning quality of B.2935, it appears that Ba.11569 will occupy those acreages in the lower rainfall district where one ratoon crop is grown.

B.726. The value of this variety as a plant cane and ratoon for earlier reaping in the higher rainfall district is acknowledged. In the intermediate rainfall districts and in the deep valley soils it is practically the only variety grown. In the lower rainfall districts it occupies a considerable proportion of the plantings, being useful for early reaping on account of an early high juice quality, and for late reaping on account of the comparative soundness of its canes at this time in these districts. It is probable that B.2935, should it prove a good ratooning variety will displace it in part in the lower and lower to intermediate rainfall districts. It will probably be of advantage, even in the event of B.2935 proving a good ratooning variety, to grow a certain proportion of B.726 in these districts to provide good juices early in crop.

B.891. On account of the high susceptibility of Ba.11569 to the leaf symptoms of gumming disease and the uncertainty as to the degree of destruction which gumming disease might cause in that variety, B.891 was recommended for planting in the lower and lower to intermediate rainfall districts during seasons 1930-32 to 1931-33. In such districts it can be seen, from a summary of plantation returns presented in Section III., page 31, of the 1932-33 Report, that it performed equally well as Ba.11569 in yield as a plant cane, although it was inferior to the latter in yield as a first ratoon.

The results of select seedling trials and the variety trials summarised above show that, in respect to yields as plant canes, Ba.11569 is superior to it under conditions giving low tonnages—below twenty-five tons per acre—but that as tonnages increase, B.891 tends to increase in yield to a greater extent than Ba.11569 such that it equals, and even surpasses the latter variety at average yields of about 30 tons per acre upwards. At this stage, however, B.726 is superior to B.891, both as a plant cane and ratoon. These considerations limit the claims of B.891 to a plant cane variety for the lower rainfall districts, for, as stated above, it is inferior to Ba.11569 as a ratooner here. It has been already shown that the new variety, B.2935 is superior to B.891 as a plant cane. Thus the conclusion is that, with B.2935 available, there is no apparent advantage in growing B.891.

To summarise these individual variety notes, it is evident that four varieties only need be considered for the present in Barbados, i.e. B.H.10(12), B. 726, B.2935, and Ba.11569. The last named is retained only on its usefulness as a ratoon under low rainfall conditions, but its elimination will follow should B.2935 ratoon well.

The usual planting recommendations will be made to individual estates, working on the following scheme for variety allocation. The dominant variety in each area is mentioned first:—

(1) High	Rainfall	Areas—	B.H.10(12) B.726
(2) Intermediate to High	„	„	B.726, B.H.10(12)
(3) Intermediate	„	„	B.726
(4) Lower to Intermediate	„	„	B.726
		„	B.2935
(5) Low	„	„	B.2935
		„	B.726
		„	Ba.11569

It is possible that further trials will suggest the dominance of B.2935 in the fourth category, and its planting on a smaller scale in the third category.

Plant cane variety trials for season 1934-36 will include the promising new varieties B.3013 and B.3234.

SECTION II — SWEET POTATO.

A. VARIETY TRIALS.

(i) *Sweet Potato Catch Crop Trial.*

This trial was carried out at Mangrove plantation during the rainy season in 1933:—

In all fifteen varieties were tested. These were made up as follows:—

(1) Standard local varieties—

Red Nut and Six Weeks.

(2) Barbados seedlings of the first series—

B.1, B.4, B.6, B.7, B.9, B.11, B.13, B.14, B.15, B.44.

(3) Imported Varieties—

V.52 (St. Vincent) Egyptian (Mauritius) and Brook's seedling No. 23 (Australia).

The lay-out consisted of four randomised blocks, and the plot size was 40 cane holes (i.e. approx. 1/30 acre).

The trial was planted in July, 1933, and dug at two times, i.e., November and December, this being done to facilitate the sale of the potatoes. The usual field data was taken at digging. The results are used in summarising the variety trials.

(ii) Sweet Potato Long Crop Trial.

This trial was planted at Rock Hall Plantation in October, 1933, and dug in May, 1934.

In all fifteen varieties were tested. These are:—

(1) Standard varieties—
Trinidadian, Red Nut, Six Weeks.

(2) Barbados seedlings—
B.1, B.2, B.4, B.5, B.6, B.9, B.11, B.13, B.14, B.15, B.44.

(3) The Imported variety—
V.52.

The lay-out consisted of eight randomised blocks, and the plot size was 16 cane holes (approx. 1/100 acre.)

The usual field data was taken, and, in addition, cooking tests were made on nine promising seedlings and a storage test on the same nine seedlings and two varieties, i.e. Trinidadian and V.52.

The cooking test consisted in sending samples of three to four average size potatoes of each variety to four households. Reports were received for each on features such as flesh colour, texture, sweetness, and general opinions given as to the acceptability of each.

The storage test was carried out at Codrington Experiment Station during May and June. Samples of approximately seven pounds of each variety to be stored were placed in specially constructed lath work crates. The following features were noted at weekly intervals for a period of five weeks:—

(1) Weight and number of sound potatoes.
(2) Shrinkage.
(3) Number of rotten potatoes.
(4) Degree of sprouting.

Tables illustrating these features for each variety at each weekly examination were prepared.

(iii) Summary on the Present Status of Varieties.

This summary is made on the results of field trials, cooking and storage tests. The commercial varieties—Red Nut, Six Weeks, and Trinidadian—are used for purposes of comparison and are not considered here.

Of the imported varieties V.52 has definitely proved its value over all tests as a variety for catch or long cropping purposes. It gives a high yield of easily dug potatoes. The skin and flesh are white. The flesh is tinged pale green on cooking. The taste is generally acceptable. In storage the potatoes tend to

sprout, but they remain wonderfully sound. In this respect the variety equals Trinidadian which is a reputedly good storage variety. It gives much higher yields than the latter variety.

V.52 has been recommended for planting on a commercial scale.

This is the only imported variety which has survived all tests and merits planting on a commercial scale; the other two—Egyptian and Brook's Seedling No. 23—surviving up to the catch crop trial at Mangrove are now eliminated.

Of the seedlings of the first series surviving to the 1933-34 trials—B.1, B.2, B.4, B.5, B.6, B.7, B.9, B.11, B.13, B.14, B.15, B.44—the following have been chosen for further testing in the 1934-35 trials:—B.5, B.6, B.9, B.11, B.12, B.13, B.44. Of these, it is expected to make conclusions as to their commercial value at the end of these trials. At present both B.5 and B.44 show decided promise, giving, as they do, high yields of potatoes of attractive appearance and good eating quality.

B. Seedling Selection and Trials. Second Series.

This section reports the progress made in testing the second series of sweet potato seedlings raised in 1932 (Agric. Journal, Vol. 2, No. 3, p.29). These seedlings were grown in a first year trial at Codrington where, at digging after a growing period of sixteen weeks, 106 seedlings were selected for catch crop trials, and, after a growing period of twenty-four weeks, 100 were selected for long crop trials.

The *catch crop* trial was planted at Codrington in 1933, and grown for sixteen weeks. The trial included 106 seedlings and 2 standards—Six Weeks and Red Nut. Two randomised blocks were employed and the plot size was five cane holes. Two slips were planted in each of three hills per cane hole.

At digging selections were made on the potato features, weight, size and shape uniformity, evenness of surface, colour of skin and flesh. Thus low yielders, those with irregular size and shape of potatoes, and mixed or pronounced flesh colour were eliminated.

Twenty-eight were chosen for further trial. These were given permanent numbers, B.16—B.43 inclusive.

The *long crop* trial was planted in November, 1933, at Pickerings plantation and dug after approximately twenty-six weeks. In all 89 were planted, plus one standard—Red Nut. The lay-out and methods of digging and selection were essentially similar to that used in the catch crop trial.

Twenty-four were selected for further trial and given the permanent numbers B.46—B.69 inclusive.

Both groups of selected seedlings will be further tested during season 1934—35.

A FURTHER CONTRIBUTION TO THE ANALYSIS OF FIELD DATA ON DIATRAEA SACCHARALIS IN BARBADOS.

By R. W. E. TUCKER, M.A., B.Ed.

The study and analysis of the complete field data on *Diatraea saccharalis* in Barbados for 1933 enables progress to be made towards two new objectives. The first is, the comparison over a period of several consecutive months of ascertainable field mortalities, and of total real mortaltiy of *D. saccharalis* under conditions when *Trichogramma minutum* is colonised, with conditions under which it is not colonised: and the second is to carry the analysis of field data sufficiently far to enable the theoretical results obtained thereby, to make contact with previously and independently compiled field counts of actual borer prevalence and damage.

In a preceding paper, (1), the increase in total real mortality of *Diatraea saccharalis* in cane, due to egg parasites, egg predators, natural larval mortality and other factors, was worked out for the months of June and September, 1933. In addition, consideration was given to the probable effects of introducing and permanently establishing, at a reasonably effective level, a larval parasite such as *Lixophaga diatraea.*

The present paper deals only with field data on mortality factors of *Diatraea saccharalis*, determined over a period of eleven months in 1933, including the five months of most critical cane growth, namely May to September, and does not deal with the probable effects of introducing and establishing *Lixophaga*.

The latter parasite has indeed now been introduced into Barbados (July to September, 1934), but its permanent establishment, and level of effective parasitism will not be determinable until 1936 at the earliest, and does not concern the following analysis of data.

The field, or apparent values, of the factors F1, F2, F3, F4 and F5 which operate on each *Diatraea* cycle or generation have been determined over a period of eleven months. Unfortunately it is not possible to obtain a series of observations on all mortality factors for every month, particularly when the factor F2 has two values to be determined, namely the colonised value and the uncolonised value. Any month, therefore, in which one of the variable factors has not been determined has to be omitted from mathematical calculations.

Further, the difficulties of obtaining accurate field data from the end of September onwards in ripening cane are considerable, as, owing to the dense growth of the cane and to the physical discomfort of working among such

growth for long periods under a tropical sun, the field error under such conditions is quite probably large. Therefore, although figures for eleven months are given in Table I, it is not proposed to use more than those from March to September; even this range has to be narrowed down when the results of theoretical analysis of the field data are compared with actual recorded field results, because the required field results are not available for all months. This is due to the fact that the correlation of theoretical or mathematical results with practical field results was not premeditated, and to the fact that one of the most important field results, namely large scale field counts of dead hearts as a yearly index of borer infestation, usually ceases in May each year.

The contact between theoretical figures for borer prevalence obtained from the analysis of accumulated field data, with practical counts of borer prevalence in cane fields, is made as follows.

If one obtains the total initial *Diatraea* population per acre month by month (2), and if the total real mortality of *Diatraea* due to all known factors month by month can be calculated (1), it is obviously possible to obtain the amount of the initial population which survives per acre during each month. These surviving borers can be designated 'effective borers'.

When the number of effective borers per acre has been calculated, then, if the number of host plants (cane shoots) per acre is known for each month,* it is possible to calculate in theory the number of such cane shoots that will be penetrated by borers. Now, in practice, a cane shoot, up to a certain age, which is penetrated by an effective borer, dies, and gives rise to characteristic 'dead-heart.'

Also, up to May at least each year, the majority of cane shoots are at the age, or stage of growth, at which penetration by a borer causes them to die and form dead hearts: some, however, are large enough and vigorous enough to support an effective borer without being killed thereby, and this factor is considered below.

If, then, one can obtain counts of borer damage actually present in the fields in these months, as measured by dead hearts per acre, it is possible to compare the theoretical results with actual facts, and so to form some idea as to whether the field data on which the aforesaid theoretical calculations are based, are reasonably correct.

Contact is thus made between theoretical calculations based on field mortality data, with actual field counts; and, as will be shown, a sufficiently close agreement is obtained to indicate that the field data given and analysed herein is reasonably accurate.

Table I. gives field determined mortality factors for January to November, from which are calculated as described in (1) the total real mortalities under colonised and uncolonised conditions.

* The number of cane shoots per acre per month is known for all varieties, from the statistical compilations of the Geneticist.

Attention must be drawn to the fact that uncolonised F2 values are determined as stated in (2) and are quite possibly higher than they should be, because the plots in which counts were made most probably benefited from neighbouring field liberations of parasites. Further, colonised F2 values are estate field determinations, averaged from bi-monthly counts in around 40 fields all over the Island, (which is the reason why no F2 values are available before May). Experiments made in 1934, with direct counts between uncolonised and continuously colonised plots in the same locality, show higher figures for F2 colonised, than for F2 uncolonised.

TABLE I.

Month.	Mortality Factors Percentage.						Total Real Mortality.	
	F1.	F2. Uncolonised.	F2. Colonised.	F3.	F4.	F5.	Uncolonised.	Colonised.
							per cent.	per cent.
January ...	2	0·8	...	14·5	97·3	15·0	97·97	...
February ...	2	8·0	...	8·5	97·8	15·0	98·30	...
March ...	2	6·0	...	32·0	92·6	15·0	95·98	...
April ...	2	11·5	...	34·0	88·2	15·0	94·33	...
May ...	2	32·0	56·5	24·0	92·9	15·0	96·88	99·03
June ...	2	33·0	70·0	22·0	89·5	15·0	95·41	97·95
July ...	2	18·7	73·0	29·0	65·5	15·0	83·38	94·49
August ...	2	33·0	70·0	40·0	0·0	15·0	66·56	85·01
September ...	2	52·0	90·0	4·0	15·7	15·0	67·74	93·27
October ...	2	66·5	91·0	5·0	29·2	15·0	81·21	94·96
November ...	2	46·0	92·0	0·0	0·0	15·0	55·02	93·33

The Total Real Mortality columns in Table I, give the extent of mortality in each 100 *Diatraea* eggs laid during the month given. If these figures are subtracted from 100, we get the number of larvae which survive to damage

canes and complete their development, out of each 100 eggs laid. To eliminate decimals, we can take survivals out of every 10,000 eggs laid, with results as below:—

TABLE II.

DIATRAEA WHICH SURVIVE OUT OF EACH 10,000 EGGS LAID 1933.

Month.	Uncolonised.	Colonised.
January ..	203	
February ..	170	
March ..	402	
April ..	567	
May ..	312	97
June ..	495	205
July ..	1662	551
August ..	3344	1499
September ..	3226	671
October ..	1879	504
November ..	4498	667

Colonisation with *Trichogramma* is effective in part of February and from March onwards, but in 1933, no counts were made of parasitised eggs in colonised fields during March and April, and it was not until May that proper attention could be given to this aspect of the investigations.

It is obvious, however, that the effect of colonisations of *Trichogramma*, is to bring about a considerable reduction in the number of larvae surviving per 10,000 eggs laid.

As stated above, if one has obtained adequate data on the initial population, i.e. number of *Diatraea* eggs per acre, month by month, and if one knows the number of host plants (cane shoots) per acre, then it is possible to calculate in theory the number of cane shoots per acre which will be attacked. It is also possible to count in actual fact the number of cane shoots attacked per acre, particularly up to May, and sometimes even to June, when attacked shoots generally die and form characteristic dead hearts.

Counts of dead hearts during March, April and May have been made in Barbados during the last four years, and the counts for 1933 were made and recorded over a year before the above mathematical analysis of 1933 field mortality data was made. Hence, if the mathematical expectation of bored shoots per acre for 1933 bears a reasonable agreement with the practical findings, and if the practical findings for 1933 are borne out by previous years' counts (as they are) then the field data which gives this theoretical and practical agreement can be considered as reasonably accurate.

TABLE III.

Month.	Eggs per acre.	Survivals per acre.		Cane shoots per acre.	Theoretical shoots bored.		Counts of dead hearts per acre. 1933.
		Uncolonised.	Colonised.		Uncolonised.	Colonised.	
					per cent.	per cent.	per cent.
February ...	16,236	275	...	9,000	3·00	(·85)	...
arch ...	27,605	1,109	...	12,000	9·20	(2·60)	1·88
April ...	23,120	1,311	...	18,750	7·00	(1·98)	2·28
May ...	23,412	730	226	23,250	3·10	·97	3·87
June ...	8,608	426	176	23,250	1·83	·75	...
July ...	2,424	403	133	30,000	1·34	·44	...
August ...	2,769	926	416	20,000	3·08	1·38	...
September...	6,079	1,961	307	28,000	7·00	1·09	...

Table III gives the picture as complete as the writer has been able to make it. It is unfortunate that counts of parasitism in colonised areas were not made in February, March and April of 1933, but as stated previously, in a task of this complexity, lacunae in records are bound to occur, inasmuch as no records are taken unless a trained and reliable worker is available to make them. There are thus no theoretical figures for shoots bored per acre in March and April, to compare with the field counts made in these months; (the figures given in brackets are obtained as described in the following paragraphs). Nevertheless, the figures given in Table III bear a reasonable relation to facts found in the field.

Thus from May to September, the relation of the theoretical figures for cane shoots bored when *Trichogramma* is colonised, to the figures when there is no colonisation, i.e., when damage by borer is at the status prior to control work, is as follows:—

May.	Colonised damage		31.3	per cent.	of uncolonised damage.	
June	„	„	41.0	„	„	„
July	„	„	32.0	„	„	„
August	„	„	44.8	„	„	„
September	„	„	15.6	„	„	„

This is surely within reasonable agreement of statements already published that borer damage in Barbados has been reduced to between *one half and one third of what it was prior to control.*

It is therefore legitimate to take the average reduction of damage due to colonisation from May to September, and to apply this average to obtain figures for February, March and April. The average reduction for May to September works out at 28.3 per cent., which gives figures for colonised damage in the months of February, March and April of 0.85 per cent. shoots bored, 2.60 per cent and 1.98 per cent. as placed in brackets in their respective columns.

Further comparisons are now possible. Thus the figures given under theoretical shoots bored when *Trichogramma* is colonised, represent the percentage shoots bored per acre *for that month only.* The corresponding figure under field counts is the percentage of total shoots killed found by field counts in that month.

Two facts must therefore be taken into consideration in order to complete the comparison. The first is that field counts of dead hearts made in May include shoots killed in April and March, and possibly even some from February; the second is that dead heart counts do not give the *complete* tally of bored shoots present, because some shoots may be bored, but not yet at the dead heart stage, and this factor would be considerable in May. When field counts of dead hearts are compared with field counts of dead hearts this does not matter greatly, but in Table III we are comparing field counts of dead hearts with theoretical figures of shoots bored. To arrive at comparable figures for May, it is necessary to add together the theoretical figures for March, April and May, in order to obtain the total which would actually be present in the field in May: this total is then comparable with the count of bored shoots which are found by field examinations in May. Finally it is necessary to add a correction to the field count in May to allow for shoots in which *borers are present,* but which are not counted because they have not reached the dead heart stage. The correction to be thus made must necessarily be somewhat arbitrary, and depends upon field knowledge and experience. It is considered that 20 per cent extra would be a fair but moderate reckoning for shoots that have borers in them in May, but are not counted in the dead heart tally.

This, then, brings the May *field count* to 3.87+.77=4.64 per cent. of shoots per acre damaged by borer.

The theoretical count is .97+1.98+2.60 or 5.55 per cent per acre. This, the writer considers to be within reasonable agreement, for the actual field count differs from the theoretical expectation by 16 per cent. only, and the margin of field error might very easily account for this, inasmuch as one is more likely to undercount dead hearts than to overcount them in the field, and inasmuch as the 20 per cent allowance made above for bored but not dead shoots does not err on the side of exaggeration.

From the foregoing analysis it can be seen that increasing the average parasitism of *Diatraea* eggs at a period when early larval mortality is a fluctuating factor causes an increase in the total real mortality of *Diatraea* during five to

six critical months of cane growth. Further, the theoretical results which follow the increased mortality agree quite well with field data, and substantiate this data and statements already published on reduction in borer damage following mass colonisation with *Trichogramma.*

SUMMARY.

1. Field data on the mortality factors which affect the *Diatraea* cycle in Barbados are tabulated for a period of eleven months, and total real mortalities under colonised and uncolonised conditions are worked out mathematically, as in a previous paper (Jour. Dept. Science & Agric. Barbados, Vol. 3. No. 1.).

2. From the monthly real mortality totals, larval survivals of *Diatraea* are worked out per unit population for each month.

3. As it is known from definite counts during each of these months what are the actual numbers of *Diatraea* eggs deposited per acre in each month it is possible to work out the number of larvae surviving per acre under colonised and uncolonised conditions.

4. As the number of stools per acre is known, and as the average number of shoots per stool is also known for each month, it is possible to calculate the number of these shoots which will be damaged or killed per acre, assuming one larva to one shoot. These results are also tabluated over a period of eight months.

5. Finally counts of shoots killed per acre have been made as part of routine field observations for the past three or four years, so that by comparing the 1933 field counts of dead hearts with the theoretical computation of shoots bored under colonised conditions, it is possible to ascertain the extent of agreement between theory and practice.

6. The agreement between theory and practical results is shown to be sufficiently close to substantiate the accuracy of the field data on which the theoretical calculations are based, and to justify the claims which have been put forward for reduction in infestation of *D. saccharalis* due to liberation of *T. minutum.*

REFERENCES.

(1) Tucker, R. W. E. 1933. Rate of Egg Deposition of *Diatraea saccharalis* and Extent of Larval Mortality in Canefields, and their Relation to Control of *Diatraea* by *Trichogramma minutum.* Agric. Journal, Dept. Science and Agric., Barbados, Vol. 2. No. 4, page 33.

(2) „ „ 1933. A contribution towards the Solution of the Problem of Control of *Diatraea saccharalis* in cane through a *Mathematical* Evaluation of the Real Mortality of other Factors. Agric. Jour. Dept. Science & Agric., Barbados, Vol. 3. No. 1.